

Lower Extremity Pain and Swelling

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The patient presenting with lower extremity pain and swelling in the clinical setting can pose a diagnostic challenge because the differential diagnosis is extensive. Causes of lower extremity swelling could be related to musculoskeletal, vascular, or systemic diseases. This broad differential can be narrowed down by first taking a history, which may help elucidate an etiology such as a prior injury, severe sprain, or a chronic illness such as liver or renal disease.

The next step is to determine whether the extremity swelling is acute or chronic ([Table 29-1](#)). Patients with acute swelling should be evaluated for conditions that have the potential to be limb or life threatening.

ACUTE



COMPARTMENT SYNDROME

Compartment syndrome (CS) is a painful limb- and life-threatening condition that results when perfusion pressure falls below tissue pressure in a closed anatomic space (e.g., muscle groups in the hands, arms, feet, legs, and buttocks). Acute CS is a medical emergency that requires a fasciotomy to lower the pressure within the compartment of the affected muscle group. Left untreated, acute CS leads to tissue necrosis, permanent functional impairment, infection, myoglobinuria, renal failure, and death.

Compartment syndrome can be either acute or chronic. Acute CS can be triggered by a traumatic injury, such as a contusion. Tibial fractures account for the cause of nearly 45% of CS. Acute CS usually requires a surgical intervention to preserve the muscle. Chronic CS, on the other hand, is characterized by pain and swelling caused by activity. Chronic CS improves with rest.

Many things can cause CS. Causes include intensive muscle use, snakebite, surgery, fractures, burns, intra-articular injections, infiltrated infusion, hemorrhage (especially in patients being treated with anticoagulants), and casts.

Symptoms

- Unilateral extremity swelling +++
- Always suspect CS when a patient complains of severe pain in an extremity.

Table 29-1. Differential Diagnosis of Lower Extremity Swelling

ACUTE SWELLING	CHRONIC SWELLING
Baker's cyst	Congenital vascular abnormality
Cellulitis	Congestive heart failure
Compartment syndrome	Hypoproteinemia
Deep vein thrombosis/superficial thrombophlebitis	Lymphedema
Ruptured gastrocnemius muscle	Venous stasis
Sprain or fracture	

- Tightness or burning sensation in an extremity following an injury
- Paresthesia

Signs

- Pain, severe and increasing and out of proportion to the apparent injury, especially when the muscle is stretched (passive or active)
- Increased intracompartmental pressure is the sole objective criterion for diagnosing CS. Physicians have used absolute values of intracompartmental pressure ranging between 30 and 45 mm Hg to indicate the need for a fasciotomy, but others have urged prophylactic fasciotomy with symptomatic patients who have normal pressures to prevent CS. Recently, the perfusion pressure (ΔP), the patient's diastolic blood pressure minus intracompartmental pressure of 30 to 40 mm Hg, has been suggested to be used for the threshold for fasciotomy.

Workup

- Closely observe and frequently examine the patient for muscle strength and sensory changes until swelling begins to subside. Sensory changes (e.g., loss of feeling, numbness) usually indicate the onset of decreased tissue perfusion.
- Use radiography of the affected extremity and ultrasonography to help eliminate other diagnoses.

Comments and Treatment Considerations

Pallor, poikilothermia, and pulselessness are *not* good tools for diagnosing CS, so they should not affect management.

If the affected area becomes numb or paralyzed, cell death has begun and efforts to lower the pressure in the compartment may not restore function.

Measuring intracompartmental pressure is a critical step in evaluating a patient who is suspected of having CS. However, intracompartmental pressure does *not* measure nerve and muscle ischemia because ischemia depends on the magnitude *and* duration of the elevated pressure.

A patient's comorbidities (e.g., shock and compensatory hypertension) may affect the outcome of CS. Acute compartment syndrome is a medical emergency. Immediately refer any patient

with suspected CS to an orthopedic surgeon for a possible fasciotomy.

Administer supplemental oxygen to the patient to decrease tissue damage by increasing the partial pressure of oxygen in the injured muscle. Administer appropriate antivenom in cases of venomous snake bites: antivenom reverses hypoperfusion and increases oxygenation while controlling the direct toxic effect of the venom and the accompanying inflammatory response. Mannitol and hyperbaric oxygen therapy can also benefit patients with CS.

Do *not* elevate the injured extremity in cases of suspected CS because elevation decreases arterial perfusion and results in decreased oxygenation of tissue.

In the case when a patient has a cast in place and complains, in nearly all cases the cast should be “bivalved” to relieve constricting pressure.



DEEP VEIN THROMBOSIS

DVT occurs most frequently in the lower extremities but can also occur in the inferior vena cava, the upper extremities, and the portal venous system. There are a number of risk factors for DVT (Table 29-2). Early diagnosis and management of DVT is important to avoid complications, particularly pulmonary embolism. The Wells Clinical Prediction Rules helps assess the likelihood that a patient has a DVT and guides decisions about further workup.

Table 29-2. Risk Factors for Deep Vein Thrombosis

- Recent surgery, especially orthopedic, neurosurgical, and vascular procedures
- Recent long travel
- Immobilization
- Malignancy
- Family history of thrombosis
- Acute decompensated illness (MI, acute CHF, stroke, sepsis)
- Oral contraceptive use (3 times the risk of nonusers)
- Hormone replacement therapy use (2 to 4 times the risk of nonusers)
- Pregnancy (2 times the risk of nonpregnant female)
- Postpartum (14 times the risk of average female)
- Trauma, particularly spinal cord injuries, burns, and fractures
- Coagulopathies
- Myeloproliferative disorders
- Medications: tamoxifen, chemotherapeutics, thalidomide
- Central venous catheters
- Vena cava filters
- Intravenous drug abuse
- Inflammatory bowel disease

CHF, Congestive heart failure; MI, myocardial infarction.

Symptoms

- No symptoms +++
- Unilateral extremity pain
- Unilateral extremity swelling
- Sometimes present with symptoms of pulmonary embolism

Signs

- Unilateral extremity edema
- Reddish purple, blanchable discoloration of affected extremity (phlegmasia cerulea dolens)
- Homans' sign (calf pain when foot is forcefully dorsiflexed with knee extended): present in about one third of patients with DVT and in about half of all patients without ++
- Prominence of superficial veins or superficial thrombophlebitis

Workup

- Wells Clinical Prediction Rules criteria ([Box 29-1](#)) +++++
- D-dimer—A negative D-dimer is useful as a “rule-out” DVT. False-positive D-dimers are seen in patients with cancer, extensive inflammation, trauma, recent surgery, or pregnancy. There are many different types of D-dimer assays; the ELISA tests are most reliable because they are more specific (have fewer false positives) +++++
- Doppler ultrasound—Safe, noninvasive, and reliable. A technician looks to see whether the veins can be compressed; first-line imaging test. Very accurate for proximal veins; less accurate for calf veins. May choose to repeat a negative test 1 week later to ensure no proximal spread from an undetected calf vein thrombus (serial ultrasonography). Difficult to perform on very obese patients or with profound edema. +++++
- MRI—Newest imaging modality currently being studied; may prove to be more accurate than ultrasound, but more expensive and less widely available
- Contrast venography—Gold standard with nearly 100% sensitivity and specificity. Expensive, invasive, and higher risk of complications, so not a first-line test. Not as accurate in patients with history of prior thrombosis.

Comments and Treatment Considerations

Anticoagulation with warfarin (Coumadin) should typically last for 6 months. If there was a transient risk factor likely responsible for the DVT (e.g., long travel), it may be reasonable to stop anticoagulation after 3 months in most patients older than 50, and in all more than 70 years old. Treat for longer duration, or even for lifetime, if patient has multiple risk factors for recurrence.

Initiate treatment using warfarin concurrently with either IV heparin or subcutaneous LMWH until a goal INR of 2 to 3 is reached.

Warfarin is contraindicated in pregnancy; LMWH is the preferred treatment.

Inferior vena cava filters are indicated to prevent PE in patients who have contraindications to anticoagulation or who have failed anticoagulation therapy, though they can increase risk of future DVT.

BOX 29-1 WELLS CLINICAL PREDICTION RULE FOR DEEP VEIN THROMBOSIS

Most reliable if combined with a negative D-dimer to rule out the possibility of deep vein thrombosis (DVT)

Add one point for each of the following that is applicable to the particular patient:

- Active cancer
- Paralysis or recent plaster immobilization of lower extremities
- Recently bedridden more than 3 days and/or major surgery within the past 4 weeks
- Localized tenderness along distribution of deep venous system
- Entire leg swelling
- Calf swelling more than 3 cm compared with asymptomatic leg
- Pitting edema greater than asymptomatic leg
- History of documented DVT
- Dilated collateral superficial veins (not varicose)

Subtract 2 points for any alternative diagnosis that is as likely or more likely than DVT.

Total score:

High probability: ≥ 3

Moderate probability: 1-2

Low probability: ≤ 0

Interpretation:

High probability: need imaging to rule out DVT regardless of D-dimer results; if imaging is negative, consider repeating ultrasound in 1 week to confirm negative results, particularly if D-dimer positive.

Moderate probability: if D-dimer is negative, can usually follow clinically; ultrasound might help establish an alternate diagnosis.

Low probability: no imaging necessary if D-dimer is negative; DVT essentially ruled out ($<1\%$ chance of DVT).

In order to prevent DVT in hospitalized patients, use compression stockings or automated cycling compression devices/intermittent pneumatic compression devices. Medications can include heparin 5000 units subcutaneously two or three times a day depending on risk or LMWH—enoxaparin (Lovenox) 40 mg subcutaneously daily (different dosing perioperatively). Aspirin alone is *not* effective prevention for DVT.

Workup for recurrent DVTs: more than one DVT in a patient is indicative of a possible coagulopathy. Workup should include investigation for inherited clotting disorders such as lupus anticoagulant, protein C or S deficiency, or factor V Leiden mutations.

Postthrombotic syndrome occurs in up to one third of patients after a first DVT. Symptoms include prolonged pain, swelling,

and skin changes. Risk of developing postthrombotic syndrome can be lowered by wearing compression hose for 2 years after diagnosis.

CHRONIC SWELLING



VENOUS STASIS

Venous stasis (also called venous insufficiency and venous edema) is characterized by chronic, lower extremity pitting edema, and is most often bilateral. Venous stasis is usually accompanied by skin induration, varicosities, fibrosis, and hyperpigmentation.

The incidence of venous stasis in the general population can be as high as 30%. The condition is caused by chronic venous valvular incompetence leading to peripheral venous hypertension, although the central venous pressure remains normal. About 50% of patients with venous stasis have a history of a leg injury. The most common cause of venous vascular incompetence is prior DVT, but only one third of patients with venous stasis will give a history of DVT. As the thrombosis heals, the normal venous valvular and wall structure are destroyed, leading to incompetence.

The signs and symptoms of venous stasis range from mild to severe and can be debilitating. Heat and prolonged sitting or standing may worsen the symptoms. Skin ulcers that usually develop over the medial malleoli are the most serious complication and can be very challenging to manage.

Symptoms

- Pain or dull aching ++
- Sensation of leg fullness
- Nocturnal leg cramps

Signs

- Lower extremity pitting edema (usually bilateral, but may be asymmetric and occasionally unilateral) +++++
- Varicosities
- Subcutaneous fibrosis
- Hyperpigmentation
- Cellulitis
- Skin ulcers (usually over the medial malleoli) +

Workup

- CBC (to rule out systemic infection or anemia)
- Urinalysis and a BMP (assess for renal disease)
- TSH (to rule out hypothyroidism)
- Albumin (low albumin may be a sign of liver disease, nephrotic syndrome, or protein-losing enteropathy)
- ECG, chest x-ray, CHF peptide and echocardiogram should be obtained only if a cardiac etiology for the edema is suspected by history and exam.
- If sudden, unilateral leg swelling, obtain lower-extremity Doppler studies to rule out DVT

Comments and Treatment Considerations

Venous stasis and its complications are difficult to treat, and patients usually require several treatment modalities to achieve satisfactory results. Leg elevation: simply elevating the legs above heart level for 30 minutes three or four times daily reduces edema and improves circulation.

Compression stockings: a variety of compression stockings are available, but knee-high stockings are usually sufficient for most patients. The stockings should exert at least 20 mm Hg at the ankle and less at the knee. Thigh-high stockings should be avoided because they limit venous return.

Aspirin at doses of 325 mg/day has been shown to improve ulcer healing and should be used unless contraindicated in the patient. Systemic antibiotics should only be used in cases of cellulitis or ulcer infection.

Horse chestnut seed extract has been shown to reduce leg volume and edema. Topical emollients and steroids should be used to treat stasis dermatitis. Diuretics should be avoided in patients with venous stasis because they can lead to hypoperfusion and volume depletion and generally do not relieve the edema.

Dressings, usually occlusive and with compression, should be used to cover venous stasis ulcers. Superficial venous surgery may improve symptoms and ulcer recurrence in patients with severe symptoms. Topical antibiotics, antiseptics, debriding enzymes, growth factors, and silver sulfadiazine have not been shown to be effective treatment options.

CONGESTIVE HEART FAILURE

See Chapter 16, Cough.

LYMPHEDEMA

Lymphedema is a chronic debilitating and often disfiguring condition. It is an uncommon cause of both unilateral and bilateral lower extremity swelling that results from an incompetent lymphatic system. Early in its course, this disease can be difficult to distinguish from venous stasis. It differs from venous stasis in that it is comprised of protein rich fluid in the subcutaneous tissue.

There are two types of lymphedema: primary (congenital) or secondary (acquired). Secondary lymphedema is more often observed than primary. Worldwide the most common cause of secondary lymphedema is related to the parasitic infection, filariasis. However, secondary lymphedema needs to be considered as a possible diagnosis of leg swelling in those patients with a history of pelvic malignancy, radiation therapy, or prior pelvic surgery.

Symptoms

- Unilateral or bilateral extremity swelling present for greater than 3 months
- No improvement in edema with elevation of the affected limb

- May cause aching of the affected extremity, but usually not acute pain
- Heavy sensation of the affected limb

Signs

- Nonpitting edema
- Positive Kaposi-Stemmer's sign (inability to pinch a fold of skin at the base of the second toe) ++++
- Thickening of the skin
- Warty or cobblestone appearance of the skin
- Enhanced skin creases at the toes or ankles
- Lymphorrhea (weeping of lymph fluid on to skin)
- No response to diuretics

Workup

- Evaluation to rule out more probable cause of edema (see workup for venous stasis)
- Obtain limb volume measurements of the affected and unaffected limb for comparison.
- Obtain CT or MRI only if concerned about possible pelvic malignancy
- Lymphoscintigraphy and evaluation of the lymph system may be beneficial in making the diagnosis in difficult cases. ++++

Comments and Treatment Considerations

Lymphedema is not curable and is notoriously difficult to treat. Treatment requires a lifelong commitment and often requires multiple modalities to control the symptoms; proper skin care, which may include emollients, steroid creams, or antifungal creams; and elevation of the affected limb. Lymphorrhea can promote bacterial growth on the skin. Prompt diagnosis and treatment of secondary bacterial and fungal infections are necessary to prevent further complications.

Compressive garments can be used after initial evaluation for arterial insufficiency. Manual lymphatic drainage, a form of massage, has proven to be a mainstay of treatment. Multilayer bandaging can help significantly decrease swelling. Pneumatic compression has also shown some benefit.

Regular exercise and weight management may help improve symptoms because obesity can contribute to lymphedema. Surgical intervention is rarely indicated.

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